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Japanese Kokai Patent Application
No. Hei 2[1990]-158156

SEMICONDUCTOR DEVICE, ITS FABRICATION METHOD, AND IDENTIFICATION CARD UTILIZING IT

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SEMICONDUCTOR DEVICE, ITS FABRICATION METHOD, AND IDENTIFICATION CARD UTILIZING IT

[Handotai sochi oyobi sono seizo-hoho oyobi sore wo mochiita ninshiki kaado]

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[There are no amendments to this patent.]

Claims

1. A semiconductor device in which a reinforcing layer is attached as one body with the back plane of a semiconductor element formed with an integrated circuit on one primary plane.

2. The semiconductor device described under Claim 1 in which the reinforcing layer is a polycrystalline substrate made of similar material as the semiconductor material used for the aforementioned semiconductor element.

3. The semiconductor device described under Claim 1 in which the reinforcing layer is made of a single-crystalline substrate, and the aforementioned single-crystalline substrate is

bonded onto the back plane of the aforementioned semiconductor in such a manner that the cleavage plane intersecting with the primary plane of the aforementioned single-crystalline substrate intersects with the cleavage plane intersecting with the primary plane of the semiconductor substrate which constitutes the aforementioned semiconductor element.

4. The semiconductor device described under Claim 1 in which the reinforcing layer is made of a metal.

5. A method for fabricating a semiconductor device in which a semiconductor substrate formed with many semiconductor elements on one primary plane is held by its primary plane by means of a retaining plate, the back plane of the aforementioned semiconductor substrate is polished or etched to reduce the thickness of the aforementioned semiconductor substrate, and the aforementioned retaining plate is then removed after a reinforcing layer is attached as one body with the back plane of the aforementioned semiconductor substrate in order to divide them into individual units.

6. An identification card in which the semiconductor device described under Claim 1 is mounted onto a lead frame or a resin substrate, electrodes on the aforementioned semiconductor and conductive wires on the aforementioned lead frame or the aforementioned resin substrate are connected, and a module created by covering at least the aforementioned semiconductor device using a resin is buried into a card substrate.

Detailed explanation of the invention

Industrial application field

The present invention pertains to a semiconductor device, such as an IC or an LSI, its fabrication method, and an identification card utilizing it.

Prior art

In recent years, identification cards equipped with an on-board or a built-in integrated circuit, such as a microcomputer and a memory, have been put into application.

Because said identification cards are provided with a larger memory capacity and are superior in terms of security over magnetic stripe cards which have already been in circulation in large quantity, they are considered to have been put into a variety of uses, such as a personal identification card, in addition to the usages of conventional magnetic stripe cards.

In addition, the identification card has a configuration in which a module having terminals for connection with an external device , such as a reader/writer, which contains an integrated circuit is mounted on a plastic card made of a vinyl chloride resin, and said module needs to be configured very thin. That is, because the card is defined to be 0.76 mm thick, the module needs to be restrained to a thickness of 0.6 mm or so.

Processes of the conventional method are shown in Figure 4; wherein, Figure 4a shows semiconductor substrate 21 in which many semiconductor elements are formed on its first primary plane. Although details of the semiconductor elements are omitted, in the case of a silicon substrate involving an LSI, while aforementioned semiconductor substrate 21 was 0.6 mm thick or so initially, its back plane has been polished or ground mechanically to 0.3 mm or thinner. 42 indicates the part which has been ground off. Next, aforementioned semiconductor substrate 21 is cut using a rotary grinder along dividing line 23 indicated in c in order to divide it into individual semiconductor devices 1 as indicated in d. Following the aforementioned process, die bonding, wire bonding, and packaging are applied in accordance with a normal semiconductor device fabrication method.

Because semiconductor substrate 21 was a single-crystalline substrate having a cleavage plane, its apparent strength deteriorated when it was 0.3 mm or thinner and 5 mm square in size. Accordingly, there was a problem that when a module was created using semiconductor device 1 in accordance with the conventional fabrication method and built into a identification card, semiconductor device 1 was damaged as the card was bent during installation into the card.

In addition, in the case of a method in which semiconductor substrate 21 was merely made thin, and a reinforcing plate was later adhered, when semiconductor substrate 21 was removed from the grinder after the back plane of aforementioned semiconductor substrate 21 was ground, semiconductor substrate 21 bent the plane where the integrated circuit was formed into a convex curve. As semiconductor substrate 21 was bent in said manner, a large stress was applied to the integrated circuit formed on its primary plane, creating distortion and often making the integrated circuit defective.

Problems to be solved by the invention

The present invention was developed in light of the aforementioned problems, and its purpose is to present a semiconductor device capable of sustaining sufficient strength while allowing the semiconductor device formed with an integrated circuit to be sufficiently thin, a method for making the semiconductor device thin without creating any distortion of the integrated circuit, and a very strong identification card having a thickness equal to 0.76 mm or thinner as stipulated.

Means to solve the problems

In order to solve the aforementioned problems, the semiconductor device of the present invention has a structure in which a very strong reinforcing layer is attached as one body with the back plane of a semiconductor element; and as a method for attaching the aforementioned reinforcing layer, the primary surface of the semiconductor substrate where many semiconductor

elements are formed is held by means of a retaining plate, the back plane of the aforementioned semiconductor substrate is ground under said condition, and the reinforcing layer is attached while the semiconductor substrate is attached to the retaining plate.

Operation of the invention

With the semiconductor device and its fabrication method of the present invention, because the strength of the semiconductor device is determined by the strength of the reinforcing layer attached to the back plane, and a reinforcing layer having a greater strength than that of the substrate constituting the aforementioned semiconductor elements can be selected quite easily, the semiconductor device can be made sufficiently thin without decreasing its strength.

Application example

Figure 1 is an oblique view showing a semiconductor device in accordance with an application example of the present invention. Figure 2 are cross sections showing the processes of the semiconductor device fabrication method in accordance with the application example of the present invention. Figure 3 is a cross section showing an identification card utilizing the semiconductor device of the present invention.

In Figures 1 through 3, 1 is a semiconductor device, 2 is an electrode, 3 is a semiconductor element, 4 is a reinforcing layer, 21 is a semiconductor substrate, 22 is a retaining plate, 23 is a dividing line for dividing into individual semiconductor devices, 31 is a card substrate for configuring an identification card, 32 is a lead frame, 33 is a bond, and 34 is a fine metal wire. In Figures 1 through 3, the same parts are assigned with the same symbols.

First, the semiconductor device of the application example will be explained based on Figure 1. Although the integrated circuit on semiconductor device 1 is omitted, an electrode from the integrated circuit is indicated as 2. Semiconductor device 1 comprises semiconductor element 3 formed with the integrated circuit on its primary plane and reinforcing layer 4 attached as one body with the back plane of aforementioned element 3. Assuming that reinforcing layer 4 is 10 times as strong as semiconductor element 3, the thickness of semiconductor device 1 attached with such reinforcing layer 4 on the back plane can be reduced to 1/10 in comparison to the case involving semiconductor element 3 alone. In addition, even if the strength of semiconductor device 1 in the aforementioned example is doubled, the thickness can be still reduced to 1/5th in comparison to the case involving semiconductor element 3 alone. A selection can be made from a very wide range of materials for reinforcing layer 4. For example, a polycrystalline substrate made of similar material as that used for the semiconductor chip can be used for reinforcing layer 4. For example, when semiconductor chip 3 is a silicon chip formed with an IC or LSI on its primary plane, a polycrystalline silicon substrate can be utilized as reinforcing layer 4. In other

words, while the semiconductor chip is a single crystal having a cleavage plane that cracks easily, the aforementioned polycrystalline silicon substrate has no cleavage plane because its crystal orientation is random. Thus, when said polycrystalline silicon substrate is used as reinforcing layer 4, strength of said compound body is decided based on the strength of the polycrystalline silicon substrate. In addition, when a semiconductor single-crystalline substrate [of] the same [material as that of] semiconductor element 1 is utilized, semiconductor element 3 and reinforcing layer 4 should be made into one body while preventing their cleavage planes from becoming parallel to each other to prevent cracking at a cleavage plane in order to increase the apparent strength. In addition, when an alumina substrate or a sapphire substrate is used as reinforcing layer 4, not only can the strength be assured, but semiconductor device 1 can also be made very thin. Furthermore, if necessary, a metal may also be utilized for reinforcing layer 4. In particular, when non-electrolytic plating is utilized, reinforcing layer 4 made of a metal can be attached easily without using any bond.

Next, processing steps of the semiconductor device fabrication method in accordance with the application example of the present invention will be explained based on Figure 2. Semiconductor substrate 21 formed with many semiconductor elements on one primary plane is shown in Figure 2A, and the primary plane of aforementioned semiconductor substrate 21 is attached temporarily to retaining plate 22 in the manner shown in B. Next, as shown in C, the back plane of semiconductor substrate 21 is polished or ground mechanically under said condition to make it sufficiently thin. Then, as shown in D, reinforcing layer 4 is attached as one body. Then, as shown in E, individual semiconductor device 1 is cut out along dividing line 23. When plate-like reinforcing layer 4 is used, it should be bonded using an epoxy type bond, for example. Next, semiconductor device 1 shown in F can be put through assembly processing of an ordinary semiconductor device, that is, die bonding, wire bonding, and resin sealing steps, without making any change to the facility and the conditions.

Next, the identification card into which the semiconductor device of the present invention is built will be explained based on Figure 3. For the identification card, a module having 6-7 external terminals on its surface is buried into card substrate 31 having the same thickness as that of an ordinary magnetic card. The cross section of the identification card shown in Figure 3 shows an example in which semiconductor device 1 of the present invention mounted onto lead frame 32 basically similar to a lead frame used for a popular semiconductor product is incorporated. That is, semiconductor device 1 is bonded and fixed onto the lead of lead frame 32 using bond 33. Electrodes (omitted from Figure 3) of aforementioned semiconductor device 1 and lead frame 32 are connected using fine metal wires 34. Furthermore, lead frame 32 is covered by protective resin 35 except for the plane where semiconductor device 1 is not [sic; is] mounted. These [parts] are inserted and fixed into a concave part created on card substrate 31 to

complete the identification card. In Figure 3 as the application example of the present invention, although an example in which the connection between the electrodes on semiconductor device 1 and lead frame 32 was achieved using fine metal wires 34 was explained, other connecting methods, such as a flip-chip method and a film carrier method, may also be utilized without making any change to the facility and the conditions. In addition, the thin strong semiconductor device in accordance with the present invention can offer a great effect when applied to electronic equipment, such as a calculator and a memory card, which also need to be thin like an identification card.

Effect of the invention

As described above, in the present invention, because a very strong reinforcing layer is attached as one body with the back plane of a semiconductor device which is can easily crack, not only can a thin semiconductor device which could not otherwise be realized using a semiconductor substrate alone be realized easily, but an identification card and other kinds of thin equipment and parts can also be created using the aforementioned semiconductor device.

Brief description of the figures

Figure 1 is an oblique view of a semiconductor device showing an application example of the present invention. Figure 2A through F shows cross sections of the processing steps of a method for fabricating the semiconductor device in accordance with the application example of the present invention. Figure 3 is a cross section showing an identification card utilizing the semiconductor device of the present invention. Figure 4a through d shows cross sections of the processing steps of a conventional fabrication method.

1 ... semiconductor device; 2 ... electrode; 3 ... semiconductor element; 4 ... reinforcing layer; 21 ... semiconductor substrate; 22 ... retaining plate; 23 ... dividing line; 31 ... card substrate; 32 ... lead frame; 33 ... bond; 34 ... fine metal wire; and 35 ... protective resin.

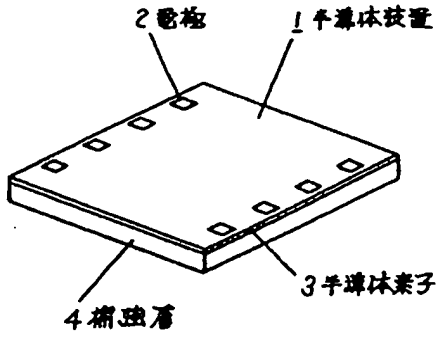

Figure 1

Key: 1 Semiconductor device
2 Electrode
3 Semiconductor element
4 Reinforcing layer

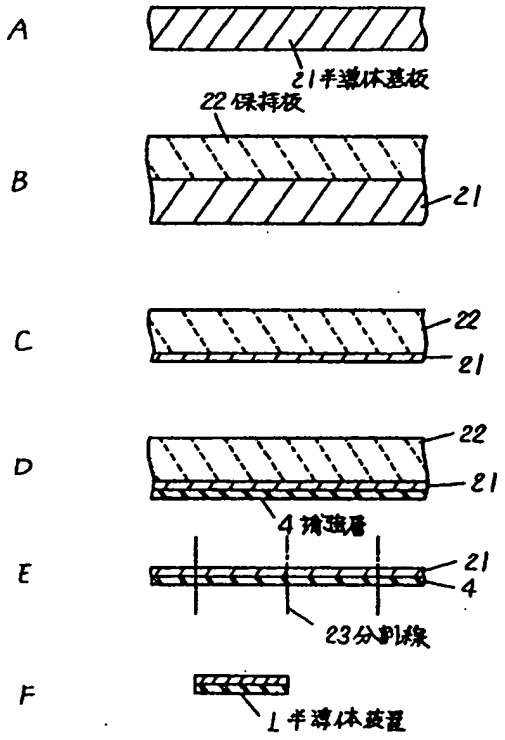

Figure 2

Key: 1 Semiconductor device
4 Reinforcing layer

21 Semiconductor substrate
22 Retaining plate
23 Dividing line

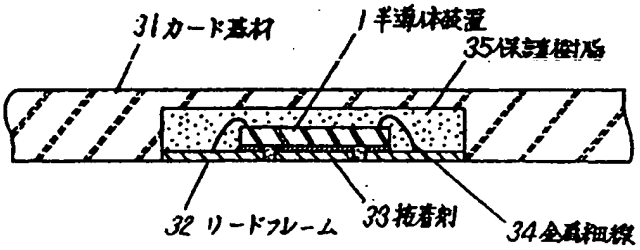

Figure 3

Key: 1 Semiconductor device
31 Card substrate
32 Lead frame
33 Bond
34 Fine metal wire
35 Protective resin

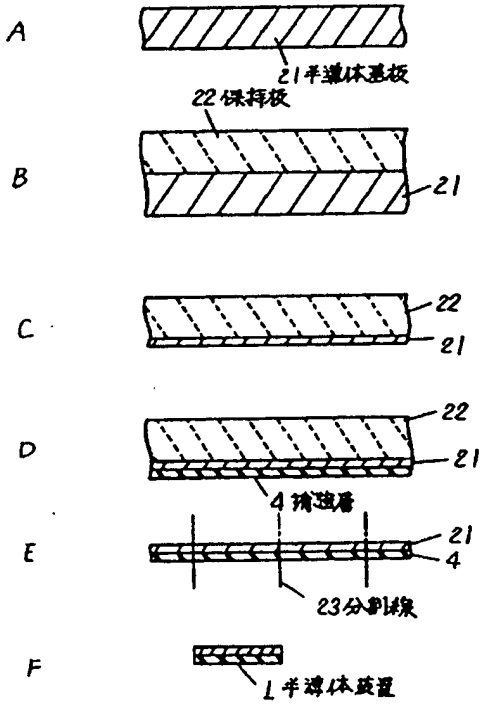

Figure 4

09/435,256

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TITLE: SEMICONDUCTOR DEVICE AND MANUFACTURE THEREOF AND IDENTIFICATION CARD USING SAME

PUBN-DATE: June 18, 1990

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US-CL-CURRENT: 29/827,257/678

ABSTRACT:
PURPOSE: To sufficiently reduce in thickness a semiconductor element without decreasing strength by integrally attaching a reinforcing layer on the rear face of the semiconductor element formed with an integrated circuit on its one main surface.

CONSTITUTION: A semiconductor device 1 is composed of a semiconductor element 3
and a reinforcing layer 4 attached integrally with the rear face of the element
3. If the strength of the reinforcing layer 4 is ten times as large as that of
the semiconductor element 3, the thickness of the semiconductor device 1 attached with the reinforcing layer 4 on its rear face can be reduced to 1/10 as compared with the case that the semiconductor device 1 is composed of only the semiconductor element 3. Even if the strength of the semiconductor device 1 is doubled, the thickness can be reduced to 1/5. The reinforcing layer 4 can
be selected from materials of very wide range. For example, as the reinforcing
layer 4, a polycrystalline board having substantially the same material as that
for forming a semiconductor chip can be employed.

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⑬公開　平成2年(1990)6月18日

審査請求　未請求　請求項の数 6　(全5頁)

⑭発明の名称　半導体装置およびその製造方法およびそれを用いた識別カード

⑳特　願　昭63-313399

㉒出　願　昭63(1988)12月12日

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明　細　書

1、発明の名称

半導体装置およびその製造方法
およびそれを用いた識別カード

2、特許請求の範囲

(1) 一主面に集積回路が形成された半導体素子の裏面に補強層を一体的に取りつけた半導体装置。

(2) 補強層が前記半導体素子を構成する半導体材料とほぼ同一材料の多結晶基板である請求項1記載の半導体装置。

(3) 補強層が単結晶基板であり、前記単結晶基板の主面と交わる劈開面が前記半導体素子を構成する半導体基板の主面と交わる劈開面と交差するようにして前記単結晶基板を前記半導体素子の裏面に接着した請求項1記載の半導体装置。

(4) 補強層が金属である請求項1記載の半導体装置。

(5) 一主面に多数個の半導体素子が形成された半導体基板をその主面側で保持板により保持し、前記半導体基板の裏面を研磨、もしくはエッチングして前記半導体基板の厚さを減じ、次に前記半導体基板の裏面に補強層を一体的に取りつけた後、前記保持板を除去し、個々に分割する半導体装置の製造方法。

(6) 請求項1記載の半導体装置をリードフレームもしくは樹脂基板上に搭載し、前記半導体装置上の電極と前記リードフレーム又は前記樹脂基板上の導体配線とを接続し、少なくとも前記半導体装置を樹脂で被覆したモジュールをカード基材に組設した識別カード。

3、発明の詳細な説明

産業上の利用分野

本発明はＩＣ，ＬＳＩ等の半導体装置およびその製造方法およびそれを用いた識別カードに関するものである。

従来の技術

近年、マイクロコンピュータ，メモリ等の集積回路をプラスチック製カードに搭載または内蔵したいわゆる識別カードが実用に供されつつある。

この識別カードは、すでに多量に使用されてい

る磁気ストライプカードに比して、記憶容量が大きく、防犯性にすぐれていることから、従来の磁気ストライプカードの用途ばかりでなく身分証明等多様な用途に供することが考えられている。

また、識別カードは、塩化ビニル樹脂のプラスチックカードにリーダ／ライター等の外部装置との接続用端子を有し集積回路を含むモジュールが搭載された構造であり、このモジュールは極めて薄型に構成することが必要とされる。即ち、カード厚みは0.76㎜に規定されているため、モジュールの厚さは0.6㎜程度に抑える必要がある。

第4図に従来工法のプロセスを示したが、第4図aは第1の主面に多数個の半導体素子が形成された半導体基板21を示している。半導体素子の詳細は省略したが、前記半導体基板21の厚みは、LSIが形成されたシリコン基板では当初0.6㎜程度であるが、その裏面を機械的に研磨、もしくは研削して厚みを0.3㎜以下にする。42は削り取った部分を示している。次にcに示す分割線23に沿って前記半導体基板21を回転砥石で切断し、dに示す如く個々の半導体装置1に分割する。上記工程の後は、通常の半導体装置の製造方法に従って、ダイスボンド，ワイヤボンド，パッケージされる。

半導体基板21は単結晶基板であり、劈開面を有しているため、その厚さが0.3㎜以下で形状が6㎜角ともなると見掛け上の強度が低下し、従来工法で作られた半導体装置1を用いてモジュールを作り、識別カードに組み込んだ際、カードが折り曲げられた時に半導体装置1が破損するなどの不都合があった。

また単に半導体基板21を薄くして、その後に補強板を貼る方法では、前記半導体基板21の裏面を研削した後、半導体基板21を研削装置から取り出した時半導体基板21が集積回路が形成された面を凸に湾曲する。このように半導体基板21が湾曲するとその主面に形成された集積回路に大きな応力がかかり、歪みが発生し、集積回路を不良にすることが多かった。

発明が解決しようとする課題

本発明は、上記問題点に鑑みてなされたもので、集積回路が形成された半導体装置の厚さを充分に薄くしそれでいて強度を充分に保ちうる半導体装置、及び集積回路に歪みを生ずることなく半導体基板を薄くする方法、及び規定された0.76㎜内にその厚さが収まった強度の高い識別カードを提供するものである。

課題を解決するための手段

上記問題点を解決するために本発明の半導体装置は、半導体素子の裏面に強度の大なる補強層を一体的に取りつけた構造であり、また前記補強層を取りつける方法は、多数個の半導体素子が形成された半導体基板の主面を保持板に保持し、その状態で前記半導体基板の裏面を研削し、半導体基板を保持板に取りつけた状態で補強層を取りつけるものである。

作用

本発明の半導体装置、及びその製造方法によれば半導体装置の強度はその裏面に取りつけられた補強層の強度で決まり、また前記半導体素子を構成する基板に比べ強度の大なる補強層を選択することは極めて容易であるため、半導体装置の厚さをその強度を下げることなく充分に薄くすることができる。

実施例

第1図は本発明の一実施例による半導体装置を示す斜視図、第2図は本発明の一実施例による半導体装置製造方法のプロセスを示す断面図、第3図は本発明の半導体装置を用いた識別カードを示す断面図である。

第1～3図において、1は半導体装置、2は電極、3は半導体素子、4は補強層、21は半導体基板、22は保持板、23は個々の半導体装置に分割するための仮想の分割線、31は識別カードを構成するカード基材、32はリードフレーム、33は接着剤、34は金属細線である。なお第1図から第3図において同一部分には同一番号を付した。

まず第1図に沿って、本発明の実施例の半導体装置を説明する。半導体装置1上の集積回路は省

略したが集積回路から導出された電極を２で示した。半導体装置１は集積回路がその主面に形成された半導体素子３と前記素子３の裏面に一体的に取りつけられた補強層４から構成されている。補強層４の強度が半導体素子３の１０倍であるとすれば、そのような補強層４を裏面に取りつけた半導体装置１では、厚さを半導体素子３のみの場合に比べ、１０分の一にすることができる。また、上記の例で半導体装置１の強度を２倍にするとしても、厚さを半導体素子３のみの場合に比べ５分の一にすることができる。補強層４としては、非常に広範囲の材料の中から選択することができる。例えば、補強層４として、半導体チップを構成する材料とほぼ同一の多結晶基板を使用することができる。例えば、半導体チップ３がＩＣ，ＬＳＩをその主面に形成したシリコンチップである場合、補強層４として多結晶シリコン基板を利用できる。即ち、半導体チップは単結晶であり、容易に割れる劈開面を有しているのに比して、前記多結晶シリコン基板は結晶方位がランダムのため劈開面を持たず、この多結晶シリコン基板を補強層４として使用した場合、これら複合体の強度は多結晶シリコン基板の強度で決まることになる。また、半導体素子１と同一半導体単結晶基板を補強層４として利用する時には、半導体素子３と補強層４のそれぞれの劈開面が平行にならないようにして一体化すれば、劈開面で割れることは無くなり、見掛け上の強度が上がる。また、補強層４としてはアルミナ基板やサファイヤ基板を使用すれば強度を確保出来る上、半導体装置１を極めて薄くすることが可能である。さらには、必要な場合、補強層４として金属を利用することができる。特に無電解めっきを利用すれば容易に、接着剤を用いることなく金属からなる補強層４を取りつけることができる。

次に、第２図に沿って、本発明の一実施例による半導体装置製造方法のプロセスステップを説明する。第２図Ａに、一主面に多数個の半導体装置が形成された半導体基板２１を示したが、前記半導体基板２１の主面をＢのごとく保持板２２に仮止めする。次にＣに示すごとく、この状態で前記半導体基板２１の裏面を機械的に研磨、もしくは研削して充分に薄くする。次にＤに示すごとく補強層４を一体的に取りつける。次にＥに示すごとく、分割線２３に沿って個々の半導体装置１に切断する。補強層４として、板状のものを用いる時は例えば、エポキシ系の接着剤で接着すればよい。次にＦに示す半導体装置１は通常の半導体装置のアセンブリプロセス、即ちダイボンド，ワイヤボンド，樹脂封止工程をなんら設備，条件を変更することなく通すことができる。

次に、第３図に沿って、本発明の半導体装置を組み込んだ識別カードについて説明する。識別カードは通常の磁気カードと同じ厚さのカード基材３１に６～７個の外部端子をその表面に有するモジュールを埋設したものである。第３図に示す識別カードの断面図は一般の半導体製品に使用されているリードフレームと基本的には同じようなリードフレーム３２に本発明の半導体装置１を搭載したものを組み込んだ例を示している。即ち、半導体装置１はリードフレーム３２のリード上に接着剤３３を用いて接着固定される。前記半導体装置１上の電極（第３図では省略）とリードフレーム３２は金属細線３４で接続される。さらに、リードフレーム３２の半導体装置１が搭載されていない面を除いて保護樹脂３５で被覆される。これらをカード基材３１に設けられた凹部に挿入・固定して識別カードが完成される。本発明の実施例である第３図では、半導体装置１上の電極とリードフレーム３２との接続を金属細線３４で行う例で説明したが他の接続方法、例えば、フリップチップ法やフィルムキャリヤ法なども何ら設備，工程を変更することなく用いることができる。また本発明による薄くて強度の高い半導体装置は、識別カード以外に薄型化を要求される電子機器例えば、電卓やメモリカードに適用して多大の効果がある。

発明の効果

以上のように、本発明によれば、極めて割れ易い半導体素子の裏面に強度の高い補強層を一体化

することにより、半導体基板のみでは実現不可能であった薄さの半導体装置を容易に実現できる上、前記半導体装置を用いて極めて信頼性の高い識別カードやその他の薄型機器，薄型部品を作ることができる。

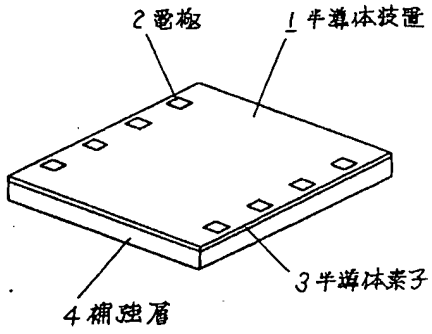
4、図面の簡単な説明

第1図は本発明の一実施例を示す半導体装置の斜視図、第2図A～Fは本発明の一実施例による半導体装置の製造方法のプロセスステップを示す断面図、第3図は本発明の半導体装置を用いた識別カードを示す断面図、第4図a～dは従来の製造方法のプロセスステップを示す断面図である。

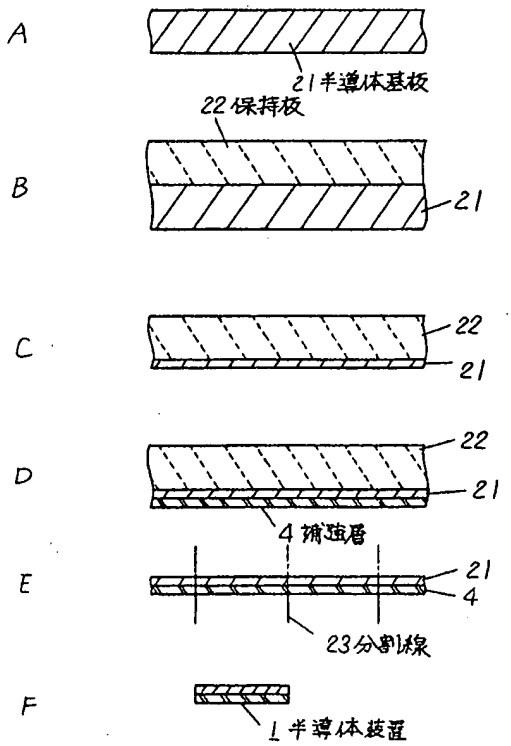
1……半導体装置、2……電極、3……半導体素子、4……補強層、21……半導体基板、22……保持板、23……分割線、31……カード基材、32……リードフレーム、33……接着剤、34……金属細線、35……保護樹脂。

代理人の氏名　弁理士　栗　野　重　孝　ほか1名

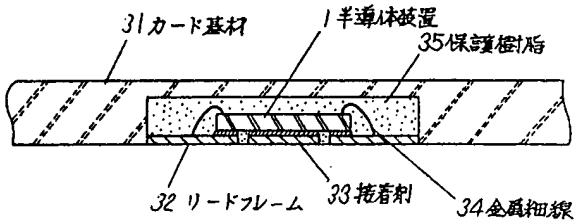
第　1　図



第　2　図



第　3　図



第 4 図